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Subject: Background Information for Revised AP-42 Section 11.19.2, Crushed Stone Processing
Review and Update Remaining Sections of Chapter 8 (Mineral Products Industry) of AP-42
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I. INTRODUCTION

This memorandum presents the background information that was used to develop the revised AP-42 Section 11.19.2, previously Section 8.19.2, on crushed stone processing. Emission data from eight emission tests conducted at stone (granite and limestone) processing plants were used to develop emission factors for various crushing, screening, and conveying operations. Descriptions of these test reports are provided in Section II of this memorandum. In addition, the references from the previous version of AP-42 Section 8.19.2 were reviewed. Tables 1 and 2 present PM-10 emission data and the new PM-10 emission factors developed for inclusion in the revised AP-42 section. Tables 3 and 4 present filterable PM emission data and the new filterable PM emission factors developed for inclusion in the revised AP-42 section. The AP-42 section narrative also was revised to include current terminology and industry practices. The final AP-42 section is provided as the attachment.

II. DESCRIPTION OF REFERENCES

A. Reference 1

This test report documents an emission test conducted at a Martin Marietta stone crushing plant in Raleigh, North Carolina. The test was conducted for the Emission Inventory Branch (EIB) of the U. S. Environmental Protection Agency (EPA) as part of an emission test program undertaken to provide emission data on stone crushing for AP-42 emission factor development. Uncontrolled and controlled particulate matter less than 10 micrometers (μm) in diameter (PM-10) emissions from a Deister vibrating screen were measured using EPA Method 201A in conjunction with a track-mounted hood system that was used to capture fugitive emissions from the screen. The Deister screen consists of three vertically stacked decks. The upper deck has a mesh opening of 2.86 centimeters (cm) square (1.125 inches [in.] square) for the first 3.66 meters (m) (12 feet [ft]) and 2.54 cm square

TABLE 1. SUMMARY OF EMISSION DATA FOR PM-10 EMISSIONS FROM CRUSHED STONE PROCESSING TEST REPORTS[a]

Data Rating: A

Source (material)	Average material moisture content[b]	No. of test runs	Emission factor range, kg/Mg (lb/ton)	Average emission factor, kg/Mg (lb/ton)	Ref No.
Screening (granite)	0.48%	3	0.0010-0.0075 (0.0020-0.015)	0.0035 (0.0070)	1
Screening (granite)	1.57%	3	0.00028-0.00037 (0.00056-0.00073)	0.00031 (0.00061)	1
Tertiary crushing (granite)	0.44%	3	0.00075-0.0010 (0.0015-0.0020)	0.00090 (0.0018)	2
Tertiary crushing (granite)	1.77%	3	0.00017-0.00055 (0.00034-0.0011)	0.00042 (0.00083)	2
Tertiary crushing (granite)	0.70%	3	0.0011-0.0031 (0.0021-0.0062)	0.0020 (0.0040)	3
Tertiary crushing (granite)	1.78%	3	0.000075-0.00019 (0.00015-0.00037)	0.00013 (0.00026)	3
Screening (granite)	0.70%	3	0.012-0.015 (0.024-0.030)	0.014 (0.027)	3
Screening (granite)	1.78%	3	0.00049-0.00055 (0.00097-0.0011)	0.00050 (0.0010)	3
Fines crushing (granite)	0.97%	3	0.0017-0.013 (0.0034-0.026)	0.0075 (0.015)	4
Fines crushing (granite)	1.92%	3	0.00055-0.0013 (0.0011-0.0026)	0.0010 (0.0020)	4
Fines screening (granite)	< 1.5%	3	0.021-0.050 (0.042-0.10)	0.036 (0.071)	4
Fines screening (granite)	1.68%	3	0.00060-0.0015 (0.0012-0.0030)	0.0011 (0.0021)	4
Conveyor transfer point (granite)	0.27%	3	0.00010-0.00021 (0.00020-0.00042)	0.00014 (0.00028)	5
Conveyor transfer point (granite)	0.66%	3	3.1×10^{-5}-5.9×10^{-5} (6.1×10^{-5}-1.2×10^{-4})	4.6×10^{-5} (9.2×10^{-5})	5
Conveyor transfer point (granite)	0.33%	3	0.00037-0.00081 (0.00074-0.0016)	0.00053 (0.0011)	5

Table 1. (continued)

Source (material)	Average material moisture content[b]	No. of test runs	Emission factor range, kg/Mg (lb/ton)	Average emission factor, kg/Mg (lb/ton)	Ref No.
Conveyor transfer point (granite)	1.11%	3	$9.0x10^{-6}$-$2.6x10^{-5}$ ($1.8x10^{-5}$-$5.1x10^{-5}$)	$1.5x10^{-5}$ ($3.0x10^{-5}$)	5
Conveyor transfer point (granite)	0.29%	3	0.0013-0.0016 (0.0025-0.0033)	0.0015 (0.0029)	6
Conveyor transfer point (granite)	2.62%	3	$9.4x10^{-6}$-$1.3x10^{-5}$ ($1.9x10^{-5}$-$2.5x10^{-5}$)	$1.1x10^{-5}$ ($2.2x10^{-5}$)	6
Tertiary crushing (limestone)	0.88%	3	0.00092-0.0020 (0.0018-0.0041)	0.0015 (0.0029)	7
Tertiary crushing (limestone)	2.07%	3	0.00033-0.00083 (0.00066-0.0017)	0.00053 (0.0011)	7
Screening (limestone)	0.88%	3	0.0033-0.017 (0.0067-0.033)	0.0092 (0.018)	7
Screening (limestone)	2.07%	3	0.00032-0.0011 (0.00064-0.0023)	0.00061 (0.0012)	7
Tertiary crushing (limestone)	0.67%	3	0.00039-0.0065 (0.00079-0.0013)	0.0052 (0.0010)	8
Tertiary crushing (limestone)	1.44%	3	0.000053-0.000095 (0.00011-0.00019)	0.000074 (0.00015)	8
Screening (limestone)	0.67%	3	0.0033-0.0036 (0.0067-0.0073)	0.0035 (0.0069)	8
Screening (limestone)	1.44%	3	0.00024-0.00030 (0.00049-0.00059)	0.00027 (0.00055)	8

[a]Emission factors in units of material throughput (process) unless noted.
[b]Moisture content <1.5% indicates uncontrolled and $\geq$1.5% indicates controlled emissions.

TABLE 2. SUMMARY OF PM-10 EMISSION FACTORS[a]

(Factors represent uncontrolled emissions unless noted)

Process (SCC)	No. of tests	Average emission factor, kg/Mg (lb/ton)	Emission factor rating	Ref. Nos.
Screening (3-05-020-02,-03)	4	0.0076 (0.015)	C	1, 3, 7, 8
Screening with wet suppression (3-05-020-02,-03)	4	0.00042 (0.00084)	C	1, 3, 7, 8
Tertiary crushing (3-05-020-03)	4	0.0012 (0.0024)	C	2, 3, 7, 8
Tertiary crushing with wet suppression (3-05-020-03)	4	0.00029 (0.00059)	C	2, 3, 7, 8
Fines crushing (3-05-020-05)	1	0.0075 (0.015)	E	4
Fines crushing with wet suppression (3-05-020-05)	1	0.0010 (0.0020)	E	4
Fines screening (3-05-020-)	1	0.036 (0.071)	E	4
Fines screening with wet suppression (3-05-020-)	1	0.0011 (0.0021)	E	4
Conveyor transfer point (3-05-020-06)	3	0.00072 (0.0014)	D	5, 6
Conveyor transfer point with wet suppression (3-05-020-06)	3	2.4×10^{-5} (4.8×10^{-5})	D	5, 6

[a]Emission factors in units of material throughput (process) unless noted.

TABLE 3. SUMMARY OF EMISSION DATA FOR FILTERABLE PM EMISSIONS FROM CRUSHED STONE PROCESSING TEST REPORTS[a]

Data Rating: B (unless otherwise noted)

Source (material)	Average material moisture content[b]	No. of test runs	Emission factor range, kg/Mg (lb/ton)	Average emission factor, kg/Mg (lb/ton)	Ref No.
Tertiary crushing (granite)	0.70%	3	0.021-0.045 (0.043-0.091)	0.037 (0.074)	3
Tertiary crushing (granite)	1.78%	3	0.00016-0.00071 (0.00032-0.0014)	0.00044 (0.00087)	3
Screening (granite)	0.70%	3	0.062-0.16 (0.12-0.31)	0.097 (0.19)	3
Screening (granite)	1.78%	3	0.00096-0.0018 (0.0019-0.0035)	0.0015 (0.0029)	3
Fines crushing (granite)	0.97%	3	0.13-0.58 (0.26-1.2)	0.36 (0.72)	4
Fines crushing (granite)	1.92%	3	0.065-0.11 (0.13-0.23)	0.067 (0.13)	4
Fines screening (granite)	< 1.5%	3	0.11-0.18 (0.22-0.37)	0.15 (0.30)	4
Fines screening (granite)	1.68%	3	0.00096-0.0027 (0.0019-0.0054)	0.0018 (0.0036)	4
Conveyor transfer point (granite)	0.27%	3	0.0012-0.0023 (0.0023-0.0046)	0.0015 (0.0031)	5
Conveyor transfer point (granite)	0.66%	3	9.3×10^{-5}-0.00019 (0.00019-0.00037)	0.00014 (0.00028)	5
Conveyor transfer point (granite)	0.33%	3	0.0054-0.0087 (0.011-0.017)	0.0078 (0.014)	5
Conveyor transfer point (granite)	1.11%	3	2.3×10^{-5}-6.5×10^{-5} (4.6×10^{-5}-1.3×10^{-4})	3.8×10^{-5} (7.6×10^{-5})	5
Conveyor transfer point (granite)	0.29%	3	0.033-0.036 (0.066-0.071)	0.034 (0.069)	6
Conveyor transfer point (granite)	2.62%	3	1.3×10^{-5}-2.5×10^{-5} (2.6×10^{-5}-5.0×10^{-5})	1.9×10^{-5} (3.8×10^{-5})	6
Conveyor transfer point[c] (granite)	0.29%	3	0.014-0.035 (0.029-0.069)	0.028 (0.055)	6
Conveyor transfer point[c] (granite)	2.62%	3	1.1×10^{-5}-8.1×10^{-5} (2.3×10^{-5}-1.6×10^{-4})	4.0×10^{-5} (8.0×10^{-5})	6

Table 3. (continued)

Source (material)	Average material moisture content[b]	No. of test runs	Emission factor range, kg/Mg (lb/ton)	Average emission factor, kg/Mg (lb/ton)	Ref No.
Tertiary crushing (limestone)	0.88%	3	0.0032-0.012 (0.0064-0.023)	0.0073 (0.015)	7
Tertiary crushing (limestone)	2.07%	3	0.00067-0.0022 (0.0013-0.0043)	0.0013 (0.0025)	7
Screening (limestone)	0.88%	3	0.016-0.10 (0.032-0.21)	0.073 (0.15)	7
Screening (limestone)	2.07%	3	0.0020-0.014 (0.0040-0.029)	0.0062 (0.012)	7
Tertiary crushing (limestone)	0.67%	3	0.00064-0.014 (0.0013-0.027)	0.0096 (0.019)	8
Tertiary crushing (limestone)	1.44%	3	0.00042-0.00074 (0.00083-0.0015)	0.00064 (0.0013)	8
Screening (limestone)	0.67%	3	0.012-0.052 (0.025-0.10)	0.037 (0.074)	8
Screening (limestone)	1.44%	3	0.0016-0.0021 (0.0031-0.0043)	0.0019 (0.0037)	8
Conveyor transfer point[d] (limestone)	[e]	3	$1.0x10^{-5}$-$2.0x10^{-5}$ ($2.0x10^{-5}$-$4.0x10^{-5}$)	$1.5x10^{-5}$ ($3.0x10^{-5}$)	9
Primary crushing[d] (limestone)	[e]	3	0.00010-0.00065 (0.00020-0.0013)	0.00035 (0.00070)	9
Screening[d] (limestone)	[e]	3	$1.0x10^{-5}$-0.001 ($2.0x10^{-5}$-0.002)	0.00037 (0.00074)	9
Screening[f]	[e]	9	0.013-0.16 (0.025-0.33)	0.083 (0.17)	10
Screening[f]	1.5%	9	0.0011-0.011 (0.0021-0.023)	0.0038 (0.0076)	10
Screening[f]	1.5%	9	0.00070-0.021 (0.0014-0.042)	0.0082 (0.016)	10

[a]Emission factors in units of material throughput (process) unless noted.
[b]Moisture content <1.5% indicates uncontrolled and $\geq$1.5% indicates controlled emissions.
[c]Data are A-rated.
[d]Data are C-rated.
[e]Material moisture content is assumed to be low because wet suppression was not used.

Table 3. (continued)

[f]Data include emissions from three different types of screens.

TABLE 4. SUMMARY OF FILTERABLE PM EMISSION FACTORS[a]

(Factors represent uncontrolled emissions unless noted)

Process (SCC)	No. of tests	Average emission factor, kg/Mg (lb/ton)	Emission factor rating	Ref. Nos.
Screening (3-05-020-02,-03)	4	0.073 (0.15)	E	3, 7, 8, 10
Screening with wet suppression (3-05-020-02,-03)	5	0.0042 (0.0084)	E	3, 7, 8, 10
Tertiary crushing (3-05-020-03)	3	0.018 (0.036)	E	3, 7, 8
Tertiary crushing with wet suppression (3-05-020-03)	3	0.00079 (0.0016)	E	3, 7, 8
Fines crushing (3-05-020-05)	1	0.36 (0.72)	E	4
Fines crushing with wet suppression (3-05-020-05)	1	0.067 (0.13)	E	4
Fines screening (3-05-020-)	1	0.15 (0.30)	E	4
Fines screening with wet suppression (3-05-020-)	1	0.0018 (0.0036)	E	4
Conveyor transfer point (3-05-020-06)	3	0.013 (0.026)	E	5, 6
Conveyor transfer point with wet suppression (3-05-020-06)	3	0.000069 (0.00014)	E	5, 6
Primary crushing (3-05-020-01)	1	0.00035 (0.00070)	E	9

[a]Emission factors in units of material throughput (process) unless noted.

(1 in. square) for the last 2.44 m (8 ft). The middle deck has a mesh opening of 1.47 cm square (0.58 in. square), and the lower deck has slot openings of 0.30 cm (0.118 in.) by 2.54 cm (1 in.). Ambient levels of PM-10 were quantified using HiVol samplers, and the ambient concentrations were subtracted from the Method 201A concentrations to determine the actual emissions from the screen. Wet suppression was used to control emissions from the screen. Water spray nozzles are located on the conveyor underneath the tertiary crusher, at one conveyor transfer point, at the top of the stream conveyor above the Deister screen, and on the inlet chute to the Deister screen. The targeted moisture contents of the raw material (granite) during the uncontrolled and controlled runs were <1.5 percent and ≥1.5 percent, respectively. Average material moisture contents are shown in Table 1. In addition, sieve analyses were performed on stone samples taken from the conveyor that feeds the screen. Silt content of the stone as sampled (wet) was negligible, and the average silt content of the sample after drying was 3.35 percent. The relatively small amount of silt particles (<75 μm) present in the raw material suggests that the potential for PM-10 emissions from the material processing operations is low.

Uncontrolled and controlled PM-10 emission factors were developed from the emission data and the material processing rates that were measured during the testing. These emission factors are shown in Table 1. The emission factors presented differ slightly from the emission factors reported in the test report because average production rates were used in the test report, whereas actual run-by-run production rates were used in the data analyses presented in this memorandum. The data are assigned an A rating. The report provided adequate detail, the test methodology was sound, and no problems were reported.

B. Reference 2

This test report documents an emission test conducted at a Martin Marietta stone crushing plant in Garner, North Carolina. The test was conducted for EIB as part of an emission test program undertaken to provide emission data on stone crushing for AP-42 emission factor development. Uncontrolled and controlled PM-10 emissions from a Model 1560 Omnicone conical-type tertiary crusher were measured using EPA Method 201A in conjunction with a quasi-stack system, which was used to capture fugitive emissions from the crusher. The crusher reduces 8.9- to 10.2-cm (3.5- to 4-in.) stone to 2.5 cm (1 in.) and smaller. The crusher inlet and outlet each were enclosed and tested separately. Wet suppression was used to control emissions from the crusher. Water spray nozzles are located on the conveyor underneath the tertiary crusher, at one conveyor transfer point, and at the entrance to the surge bin and vibrating feeder. The targeted moisture contents of the raw material (granite) during the uncontrolled and controlled runs were <1.5 percent and ≥1.5 percent, respectively. Average material moisture contents are presented in Table 1. In addition, sieve analyses were performed on stone samples taken from the conveyor that feeds the surge bin prior to the crusher. The results of the sieve analyses are not documented in the test report.

Uncontrolled and controlled PM-10 emission factors were developed from the emission data and the material processing rates that were measured during the test. These emission factors are shown in Table 1. The data are assigned an A rating. The report provided adequate detail, the test methodology was sound, and no problems were reported.

C. Reference 3

This test report documents an emission test conducted at Vulcan Materials Company stone crushing plant in Skippers, Virginia. The test was conducted for the National Stone Association to determine emission factors for various stone crushing process operations. Uncontrolled and controlled PM-10 and filterable PM emissions from a cone crusher (tertiary crusher) and a Deister vibrating screen were measured using EPA Method 201A in conjunction with a quasi-stack and a track-mounted hood system, which were used to capture fugitive emissions

from the crusher and screen, respectively. The crusher produces stone that is 7.6 cm (3 in.) and smaller in size. The Deister screen consists of three vertically stacked decks. The upper deck has a mesh opening of 2.86 cm square (1.125 in. square) for the first 3.66 m (12 ft) and 2.54 cm square (1.0 in.) for the last 2.44 m (8 ft). The middle deck has a mesh opening of 1.47 cm square (0.58 in. square), and the lower deck has slot openings of 0.30 cm (0.118 in.) by 2.54 cm (1.0 in.). Wet suppression was used to control emissions from both processes. Water spray nozzles are located on the vibrating feeder to the crusher, on the conveyor below the crusher, and on the inlet chute to the Deister screens. The targeted moisture contents of the raw material (granite) during the uncontrolled and controlled runs were <1.5 percent and ≥1.5 percent, respectively. Average material moisture contents are shown in Table 1. In addition, sieve analyses were performed on stone samples taken from a process conveyor. The average silt content of the stone as sampled (wet) was 3.3 percent, and the average silt content of the sample after drying was 4.0 percent. The relatively small amount of silt particles (<75 µm) present in the raw material suggests that the potential for PM-10 emissions from the material processing operations is low.

Uncontrolled and controlled PM-10 and filterable PM emission factors were developed from the emission data gathered and the material processing rates that were measured during the test. These emission factors are shown in Table 1. The PM-10 data are assigned an A rating. The filterable PM data are assigned a B rating. Although Method 201A is not the reference test method for quantifying filterable PM emissions, the preseparator and filter catch for the method should provide representative results for filterable PM. The report provided adequate detail, the test methodology was sound, and no problems were reported.

D. Reference 4

This test report documents an emission test at Nello L. Teer stone crushing plant in Raleigh, North Carolina. The test was conducted for EIB as part of an emission test program undertaken to provide emission data on stone crushing for AP-42 emission factor development. Uncontrolled and controlled PM-10 and filterable PM emissions from a Model 1560 Omnicone conical-type crusher (fines crusher) and a TD Seco vibrating screen (fines screen) were measured using EPA Method 201A in conjunction with a quasi-stack and a track-mounted hood system, which were used to capture fugitive emissions from the crusher and screen, respectively. The crusher reduces 2.5- to 1.9-cm (1- to 0.75-in.) stone to 0.476 cm (0.188 in.) and smaller. The screen consisted of three decks. The top and middle decks were 2.22 and 1.43 cm square (0.875 and 0.563 in. square), respectively. The bottom deck had slots 0.476 by 2.54 cm (0.188 by 1 in.). The crusher inlet and outlet were each enclosed and tested separately. Wet suppression was used to control emissions from both processes. Water spray nozzles are located at the crusher inlet, midway through the crusher body, at the crusher outlet, and at the conveyor transfer point to the screen. The targeted moisture contents of the raw material (granite) during the uncontrolled and controlled runs were <1.5 percent and ≥1.5 percent, respectively. Average material moisture contents are presented in Table 1. In addition, sieve analyses were performed on stone samples taken from the conveyor that feeds the screen and the conveyor that carries the crusher product. The results of the sieve analyses are not documented in the test report.

Uncontrolled and controlled PM-10 and filterable PM emission factors were developed from the emission data and the material processing rates that were measured during the test. These emission factors are shown in Table 1. The PM-10 data are assigned an A rating. The filterable PM data are assigned a B rating. Although Method 201A is not the reference test method for quantifying filterable PM emissions, the preseparator and filter catch for the method should provide representative results for filterable PM. The report provided adequate detail, the test methodology was sound, and no problems were reported during the valid test runs.

E. Reference 5

This test report documents an emission test at Wake Stone Corporation stone crushing plant in Knightdale, North Carolina. The test was conducted for EIB as part of an emission test program undertaken to provide emission data on stone crushing for AP-42 emission factor development. Uncontrolled and controlled PM-10 and filterable PM emissions from two separate conveyor transfer points were measured using EPA Method 201A in conjunction with quasi-stack systems, which were used to capture fugitive emissions from the two transfer points. Wet suppression was used to control transfer point emissions. Water spray nozzles are located on the exit conveyor underneath each transfer point, and at numerous other locations throughout the process. The targeted moisture contents of the raw material (granite) during the uncontrolled and controlled runs were <1.5 percent and ≥1.5 percent, respectively. Average material moisture contents are presented in Table 1. In addition, sieve analyses were performed on stone samples taken from each of the conveyor lines. The average silt content of the samples after drying was 1.4 percent for the first transfer point and 2.4 percent for the second transfer point. The relatively small amount of silt particles (<75 µm) present in the raw material suggests that the potential for PM-10 emissions from the material processing operations is low.

Uncontrolled and controlled PM-10 and filterable PM emission factors were developed from the emission data and the material processing rates that were measured during the test. These emission factors are shown in Table 1. The PM-10 data are assigned an A rating. The filterable PM data are assigned a B rating. Although Method 201A is not the reference test method for quantifying filterable PM emissions, the preseparator and filter catch for the method should provide representative results for filterable PM. The report provided adequate detail, the test methodology was sound, and no problems were reported during the valid test runs.

F. Reference 6

This test report documents an emission test at a Martin Marietta stone crushing plant in Raleigh, North Carolina. The test was conducted for the National Stone Association as part of an emission test program undertaken to provide emission data on stone crushing for AP-42 emission factor development. Uncontrolled and controlled PM-10 and filterable PM emissions from a conveyor transfer point were measured using EPA Method 201A and EPA Method 5, respectively, in conjunction with a quasi-stack system, which was used to capture fugitive emissions from the transfer point. Wet suppression was used to control transfer point emissions. Water spray nozzles are located on the exit conveyor underneath the transfer point, and at numerous other locations throughout the process. The targeted moisture contents of the raw material (granite) during the uncontrolled and controlled runs were <1.5 percent and ≥1.5 percent, respectively. Average material moisture contents are presented in Table 1. In addition, sieve analyses were performed on stone samples taken from the conveyor. The average silt content of the dried stone was 2.2 percent. The relatively small amount of silt particles (<75 µm) present in the raw material suggests that the potential for PM-10 emissions from the material processing operations is low.

Uncontrolled and controlled PM-10 and filterable PM emission factors were developed from the emission data and the material processing rates that were measured during the test. These emission factors are shown in Table 1. The PM-10 data and the filterable PM (Method 5) data are assigned an A rating. The filterable PM data from the Method 201A tests are assigned a B rating. Although Method 201A is not the reference test method for quantifying filterable PM emissions, the preseparator and filter catches for the method should provide results that are representative for filterable PM. In addition, the emission factors developed from the Method 201A data are similar to the emission factors developed using the Method 5 data. The report provided adequate detail, the test methodology was sound, and no problems were reported during the valid test runs.

G. Reference 7

This test report documents an emission test conducted at Vulcan Materials Company stone crushing plant in Bristol, Tennessee. The test was conducted for EIB as part of an emission test program undertaken to provide emission data on stone crushing for AP-42 emission factor development. Uncontrolled and controlled PM-10 and filterable PM emissions from a cone crusher (tertiary crusher) and a triple-deck vibrating screen were measured using EPA Method 201A in conjunction with a quasi-stack and a track-mounted hood system, which were used to capture fugitive emissions from the crusher and screen, respectively. The crusher produces stone 7.6 cm (3 in.) and smaller in size. The screen consists of three vertically stacked decks. The upper deck has a mesh opening of 3.175 cm square (1.25 in. square). The middle deck has a mesh opening of 1.59 cm square (0.625 in. square), and the lower deck has a mesh opening of 0.635 cm square (0.25 in. square). Wet suppression was used to control emissions from both processes. Water spray nozzles are located in the feed hopper to the crusher and on the conveyor below the crusher. The targeted moisture contents of the raw material (limestone) during the uncontrolled and controlled runs were <1.0 percent and ≥1.0 percent, respectively. Average material moisture contents are shown in Table 1. In addition, sieve analyses were performed on stone samples taken from a process conveyor. The average silt content of the stone was 1.8 percent. The relatively small amount of silt particles (<75 µm) present in the raw material suggests that the potential for PM-10 emissions from the material processing operations is low.

Uncontrolled and controlled PM-10 and filterable PM emission factors were developed from the emission data gathered and the material processing rates that were measured during the test. These emission factors are shown in Table 1. The PM-10 data are assigned an A rating. The filterable PM data are assigned a B rating. Although Method 201A is not the reference test method for quantifying filterable PM emissions, the preseparator and filter catch for the method should provide representative results for filterable PM. The report provided adequate detail, the test methodology was sound, and no problems were reported.

H. Reference 8

This test report documents an emission test conducted at Vulcan Materials Company stone crushing plant in Marysville, Tennessee. The test was conducted for EIB as part of an emission test program undertaken to provide emission data on stone crushing for AP-42 emission factor development. Uncontrolled and controlled PM-10 and filterable PM emissions from a cone crusher (tertiary crusher) and a triple-deck vibrating screen were measured using EPA Method 201A in conjunction with a quasi-stack and a track-mounted hood system, which were used to capture fugitive emissions from the crusher and screen, respectively. The crusher produces stone 7.6 cm (3 in.) and smaller in size. The screen consists of three vertically stacked decks. The upper deck has a mesh opening of 3.175 cm square (1.25 in. square). The middle deck has a mesh opening of 1.59 cm square (0.625 in. square), and the lower deck has a mesh opening of 0.635 cm square (0.25 in. square). Wet suppression was used to control emissions from both processes. Water spray nozzles are located on the vibrating feeder to the crusher. The targeted moisture contents of the raw material (limestone) during the uncontrolled and controlled runs were < 1.0 percent and ≥1.0 percent, respectively. Average material moisture contents are shown in Table 1. In addition, sieve analyses were performed on stone samples taken from a process conveyor. The average silt content of the stone was 3.25 percent. The relatively small amount of silt particles (<75 µm) present in the raw material suggests that the potential for PM-10 emissions from the material processing operations is low.

Uncontrolled and controlled PM-10 and filterable PM emission factors were developed from the emission data gathered and the material processing rates that were measured during the test. These emission factors are shown in Table 1. The PM-10 data are assigned an A rating. The filterable PM data are assigned a B rating. Although Method 201A is not the reference test method for quantifying filterable PM emissions, the preseparator

and filter catch for the method should provide representative results for filterable PM. The report provided adequate detail, the test methodology was sound, and no problems were reported.

I. Reference 9

This document, which was Reference 1 in the previous AP-42 Section 8.19.2, contains summary data from several emission tests performed at stone crushing plants. Particulate matter emissions were measured at baghouse inlets using EPA Method 5 sampling trains, and each test consisted of three runs. Emission sources, controls, material types, and emission factors for 12 tests at 5 plants were summarized in the document. Data from several of the tests were not analyzed because process rates were not documented. Data from nine of the tests were not analyzed because they represent emissions from combined sources. Data from three of the tests were used to quantify filterable PM emissions from a conveyor transfer point, a primary crusher, and a screen (referred to as a secondary screen in the document).

The data that were analyzed from the three tests described above are assigned a C rating. The test methodologies were sound, and no problems were reported during the valid test runs. However, the document did not provide original data sheets, and little detail about the raw materials was documented. The raw material is assumed to be dry because fabric filtration systems were used for emission control. The data from the other tests do not meet the minimum criteria for developing emission factors for inclusion in the revised AP-42 section.

J. Reference 10

This report, which was Reference 5 in the previous AP-42 Section 8.19.2, contains a review of emission factors developed in several of the references described above. In addition, data and emission factors from two emission tests performed by Engineering-Science are provided in Appendix C. The emission tests were conducted at two sand and gravel processing facilities, and the screens that were tested were horizontal screens. Data from these two emission tests for primary, secondary, and tertiary screening operations are combined to represent all screening operations, because no consistent correlation between the level of screening and the magnitude of PM emissions was established by the data. The quasi-stack method was used to capture fugitive emissions from the screens tested at both plants. Both tests were performed using wet impingement sampling trains (South Coast AQMD Method) for total PM, and cascade impactors for size-specific PM.

The PM data are assigned a B rating. The test methodology appeared to be sound and no problems were reported during the valid test runs. However, the report is a secondary reference, and does not provide sufficient detail to warrant an A rating. The PM-10 data are not rated because only single-run particle-size data are provided in the report.

K. Reference 11

This document, which was Reference 2 in the previous AP-42 Section 8.19.2, examines the granite crushing industry and the potential environmental impacts of industry emissions. Topics addressed include a source description, emissions, control technology, and growth and nature of the industry.

Emission factors for several granite crushing processes were developed using data from two granite processing facilities. Only summary information is provided in the document, although details on the processes and test methodology are provided. A GCA respirable dust monitor was used to sample PM-10 emissions, and emission rates were calculated using dispersion models. Emissions were sampled from several processes, including dumping to the primary crusher, and secondary crushing and screening. The monitor was placed about

100 feet from the source being sampled. No emission controls (for the plants tested) were specified, and the silt and moisture contents of the raw materials were not recorded.

The data do not meet the minimum criteria for developing emission factors for inclusion in the AP-42 section. The test methodology was not acceptable because only one monitor was used, and the monitor was too far from the source during testing. In addition, no detail about the moisture and silt contents of the raw material was provided.

L. Reference 12

This document, which was Reference 3 in the previous AP-42 Section 8.19.2, examines the stone crushing industry and the potential environmental impacts of industry emissions. Topics addressed include a source description, emissions, control technology, and growth and nature of the industry.

Emission factors for several stone crushing processes were developed using data from two traprock processing facilities. Only summary information is provided in the document, although details on the processes and test methodology are provided. A GCA Model RDM 101-4 respirable dust monitor was used to sample PM-10 emissions, and emission rates were calculated using dispersion models. Emissions were sampled from several processes, including primary crushing and unloading, secondary crushing and screening, tertiary crushing and screening, fines crushing and screening, and conveying. The monitor was placed about 100 feet from the source being sampled. No emission controls were specified, and the silt and moisture contents of the raw materials were not recorded.

The data do not meet the minimum criteria for developing emission factors for inclusion in the AP-42 section. The test methodology not acceptable because only one monitor was used, and the monitor was too far from the source during testing. In addition, no detail about the moisture and silt contents of the raw material was provided.

M. Reference 13

This document is divided into four sections, which are addressed separately in the following discussion.

Section I discusses the emission study (sponsored by the construction aggregate industry) that was performed by Monsanto Research Corporation (MRC) and The Research Corporation of New England (TRC). In addition, several conclusions about the control of fugitive dust emissions from construction aggregate processing facilities were drawn from a comparison of AP-42, MRC's source assessment studies, and the MRC-TRC study. These conclusions are: (1) AP-42 emission factors are from 10 to 10,000 times higher than the latest (1979) measurements of uncontrolled emissions; (2) baghouse emissions from aggregate crushing operations are often higher than uncontrolled emissions (apparently due to the suspension of fine particles, which are normally associated with larger particles and are not normally released to the atmosphere); (3) the emission factors developed by MRC in the source assessment program sponsored by EPA are within one order of magnitude of the emission factors developed in the MRC-TRC study, indicating that both data sets are highly reliable; (4) wet suppression can achieve between 80 and 90 percent control of the emissions from crushers; and (5) wet suppression is more efficient than fabric filters for controlling PM-10 emissions from crushers. To conclude Section I, an ambient air quality study performed at a sand and gravel production facility in Colorado is summarized. The study concluded that the sand and gravel processing operations did not have a detectable impact on air quality.

Section II documents the MRC study that included a compilation of emission data from tests at seven stone crushing plants that processed a variety of aggregates. Tests were conducted on four primary crushers, seven secondary crushers, three tertiary crushers, and two fines crushers. Aggregate types included granite (one plant), sand and gravel (two plants), traprock (one plant), and limestone (three plants). One of the limestone processing plants used wet suppression to control PM emissions. Emission factors for PM-10 and PM<50 µm were developed for all of the processes tested and were presented by process, aggregate type, and control methods.

A GCA Model RDM 101-4 dust monitor was used to detect fugitive PM emissions downwind of the process operations. The monitor was placed approximately 30 feet from the source during each tests. The "tracer gas method" was used to determine the percentage of PM-10 measured with the GCA instrument that was emitted from the source being tested. The silt and moisture contents of the raw materials were not specified.

The data from this testing program do not meet the minimum criteria for developing emission factors for the revised AP-42 section because an adequate number of downwind monitors were not used during testing. The upwind-downwind test method, specifies a minimum of five downwind samplers for a valid test.

Section III documents the TRC study that included a compilation of emission data from tests at six stone crushing plants that processed a variety of aggregates. Tests were conducted on four primary crushers, six secondary crushers, three tertiary crushers, and one fines crusher. Aggregate types included granite (one plant), sand and gravel (two plants), traprock (one plant), and limestone (two plants). The granite processing plant and both limestone processing plants used wet suppression to control PM emissions. Emission factors for PM-10 and PM<50 µm were developed for all of the processes tested, and were presented by process, aggregate type, and control methods.

A GCA Model RDM 101-4 dust monitor was used to detect fugitive PM emissions downwind of the process operations. The monitor was placed approximately 30 feet from the source during each test. The tracer gas method was used to determine the percentage of PM-10 measured with the GCA instrument that was emitted from the source being tested. The silt and moisture contents of the raw materials were not specified.

The data from this testing program do not meet the minimum criteria for developing emission factors for the revised AP-42 section because an adequate number of downwind monitors were not used during testing. The upwind-downwind test method, specifies a minimum of five downwind samplers for a valid test.

Section IV, entitled "Semi-annual Report: Ambient Air Monitoring Program, Cannon-ERTL Site," contains no data that can be used for emission factor development.

N. Reference 14

This report, which was Reference 4 in the previous AP-42 Section 8.19.2, is a compilation of emission factors from 16 test reports. The emission factors from all of the reports were rated and combined by process in order to develop a single emission factor for each process tested. Data quantifying PM-10 emissions from primary and secondary crushing operations (from NSPS test reports) were not used for emission factor development because adequate details about the test methodology are not provided, and problems with cascade impactor tests performed before about 1981 have been reported. The other data presented in this document are presented in several of the other references described in this review.

III. RESULTS OF DATA ANALYSIS

Emission factors were developed for conveyor transfer points, screening, primary crushing, tertiary crushing, fines crushing, and fines screening operations. The only data available for secondary crushing were of questionable quality and were not consistent with the emission tests included in this review. Therefore, the revised AP-42 section does not include emission factors for primary and secondary crushing of stone. However, the emission factors for tertiary stone crushing can be used as an upper limit to primary and secondary crushing.

Emissions generally were considered uncontrolled if the raw material moisture content was less than 1.5 percent and controlled if the raw material moisture content was greater than or equal to 1.5 percent. The material moisture contents in the Reference 5 and Reference 8 emission tests did not reach the targeted 1.5 percent for the controlled runs. However, data from these tests are consistent with data from other controlled tests and are treated as controlled. Table 2 presents the PM-10 emission factors and Table 4 presents the filterable PM emission factors developed using the data from References 1 through 10. The PM-10 emission factors for screening and tertiary crushing were assigned a C rating because A-rated data from four tests (which is considered a sufficient number of tests to warrant a C rating) conducted at "typical" facilities were used. The PM-10 emission factors for fines screening and crushing were assigned an E rating because data from a single A-rated test were used. The PM-10 emission factors for conveyor transfer points were assigned a D rating because data from only three tests (conducted at two typical facilities) were used. All of the filterable PM emission factors, with the exception of the primary crushing emission factor, were assigned an E rating because Method 201A, which is not the reference test method for filterable PM, was used to quantify emissions (Reference 6 included a Method 5 test). The primary crushing emission factor was assigned an E rating because it is based on a single C-rated test.

In addition to the emission factors described above, the revised AP-42 section includes emission factors for wet drilling, and truck unloading and loading that were retained from the previous version of AP-42 Section 8.19.2. Although the quality of the data upon which these emission factors was based is questionable, no other data on those sources were located during this review.

IV. REFERENCES

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2. J. Richards, T. Brozell, and W. Kirk, *PM-10 Emission Factors for a Stone Crushing Plant Tertiary Crusher*, EPA Contract No. 68-D1-0055, Task 2.84, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 1992.

3. W. Kirk, T. Brozell, and J. Richards, *PM-10 Emission Factors for a Stone Crushing Plant Deister Vibrating Screen and Crusher*, National Stone Association, Washington DC, December 1992.

4. T. Brozell, J. Richards, and W. Kirk, *PM-10 Emission Factors for a Stone Crushing Plant Tertiary Crusher and Vibrating Screen*, EPA Contract No. 68-D0-0122, U. S. Environmental Protection Agency, Research Triangle Park, NC, December 1992.

5. T. Brozell, *PM-10 Emission Factors for Two Transfer Points at a Granite Stone Crushing Plant*, EPA Contract No. 68-D0-0122, U. S. Environmental Protection Agency, Research Triangle Park, NC, January 1994.

6. T. Brozell, *PM-10 Emission Factors for a Stone Crushing Plant Transfer Point*, EPA Contract No. 68-D0-0122, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 1993.

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12. T. R. Blackwood *et al.*, *Source Assessment: Crushed Stone*, EPA-600/2-78-004L, U. S. Environmental Protection Agency, Washington, DC, May 1978.

13. *An Investigation of Particulate Emissions from Construction Aggregate Crushing Operations and Related New Source Performance Standards*, National Crushed Stone Association, Washington, DC, December 1979.

14. F. Record and W. T. Harnett, *Particulate Emission Factors for the Construction Aggregate Industry, Draft Report*, GCA-TR-CH-83-02, EPA Contract No. 68-02-3510, GCA Corporation, Chapel Hill, NC, February 1983.

Attachment: See current AP-42 section 11.19.2